FIG.1

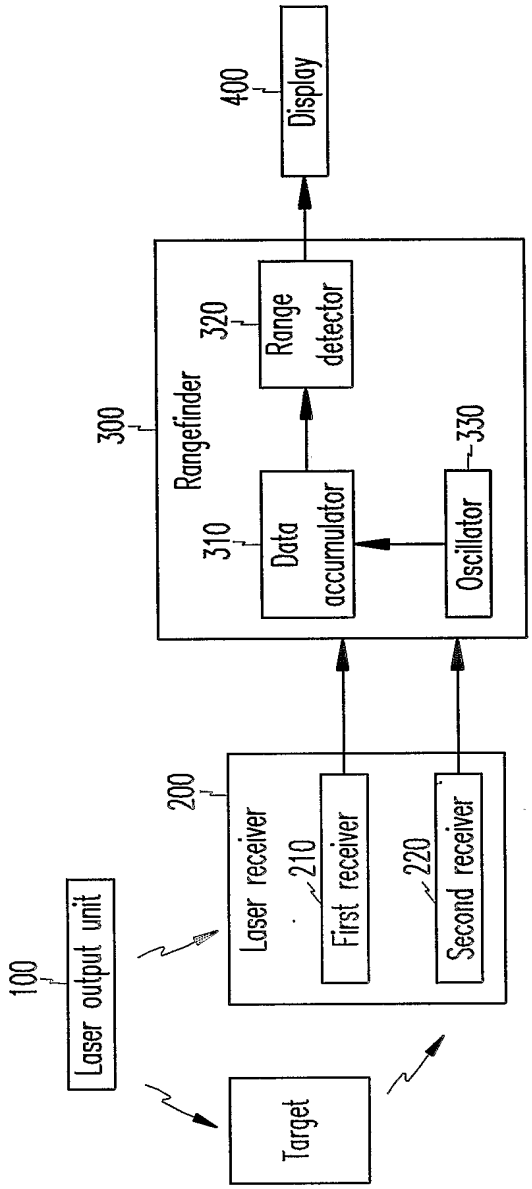

Target
100
Laser output unit
200
Laser receiver
210
First receiver
220
Second receiver
300
Rangefinder
310
Data accumulator
320
Range detector
330
Oscillator
400
Display

FIG.2

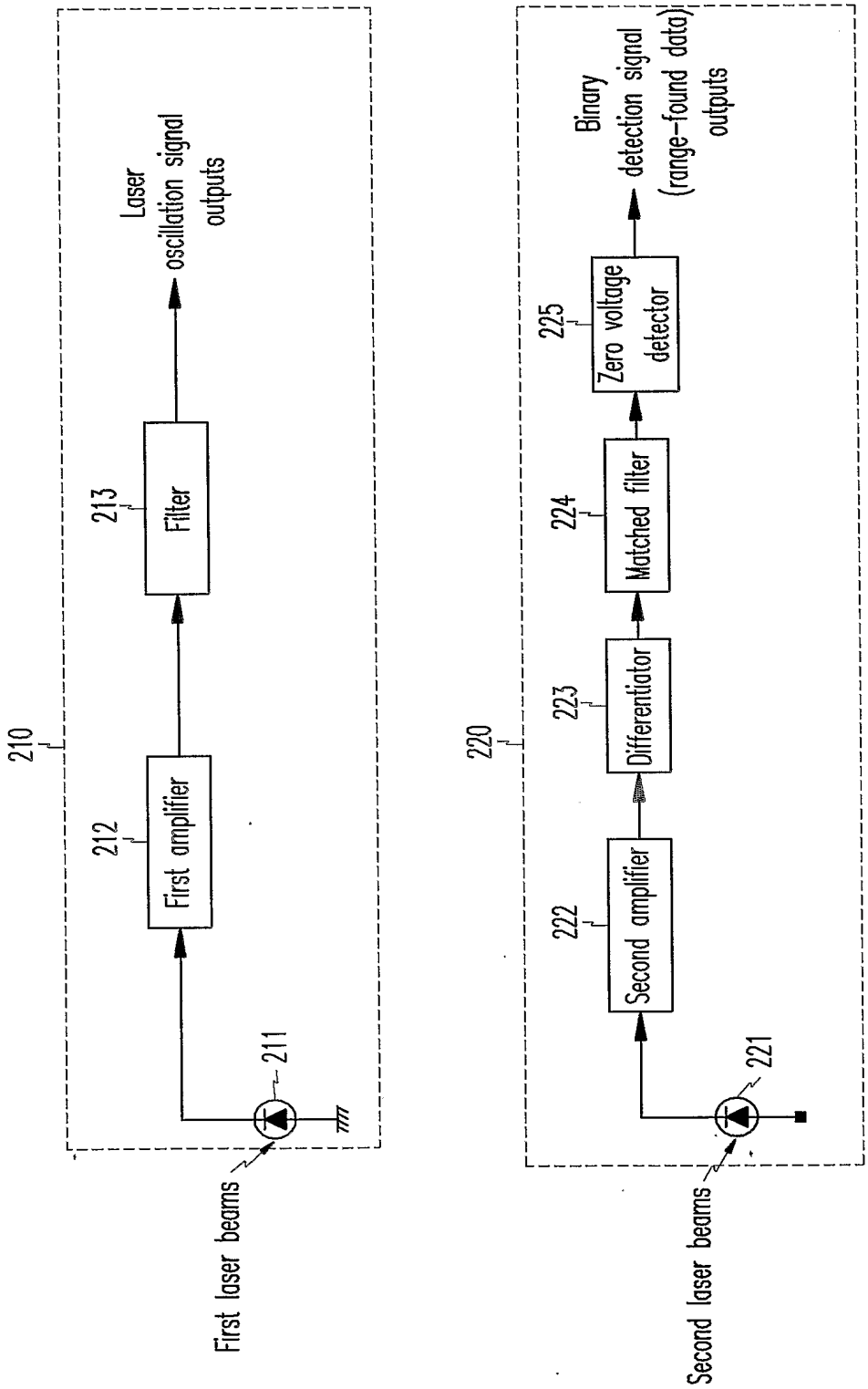

210
211
212
First amplifier
213
Filter
Laser oscillation signal outputs
First laser beams
220
221
222
Second amplifier
223
Differentiator
224
Matched filter
225
Zero voltage detector
Binary detection signal (range-found data) outputs
Second laser beams

FIG.3

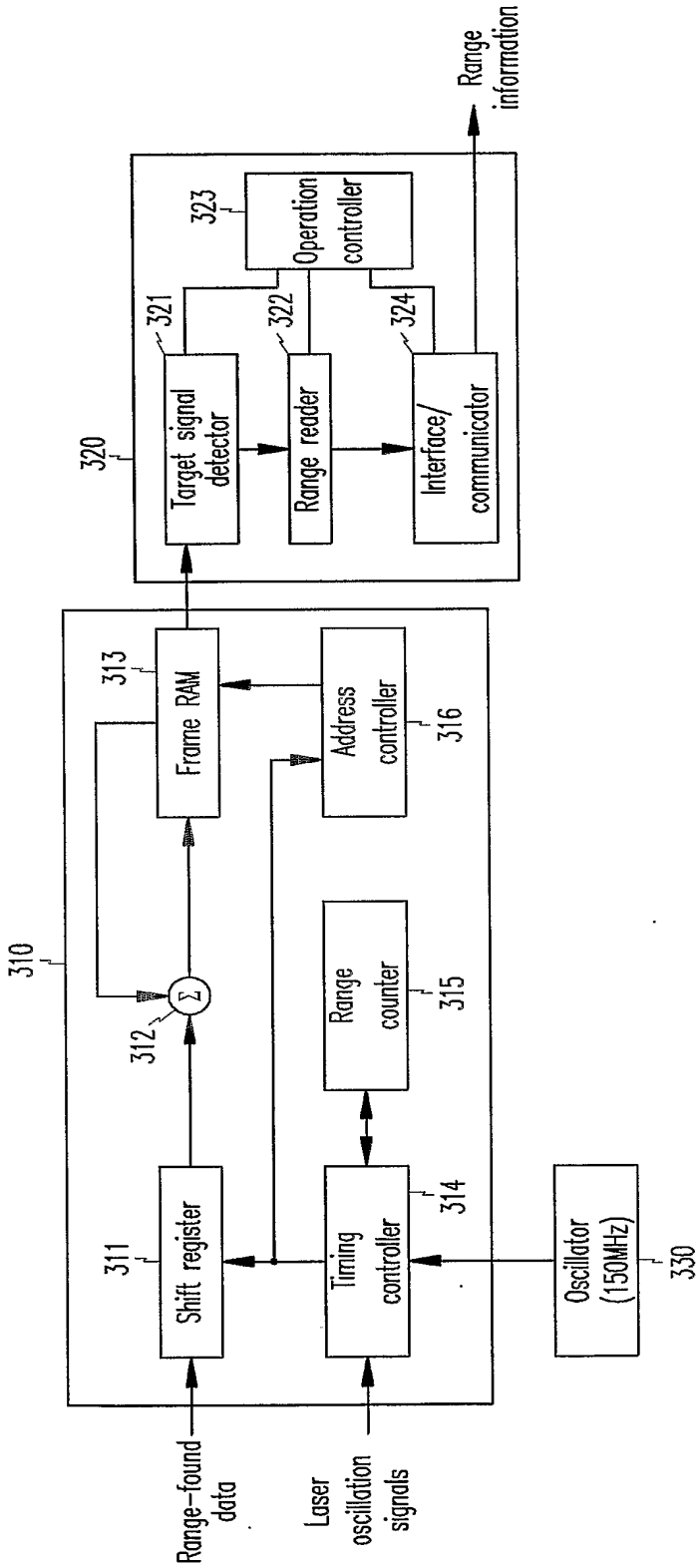
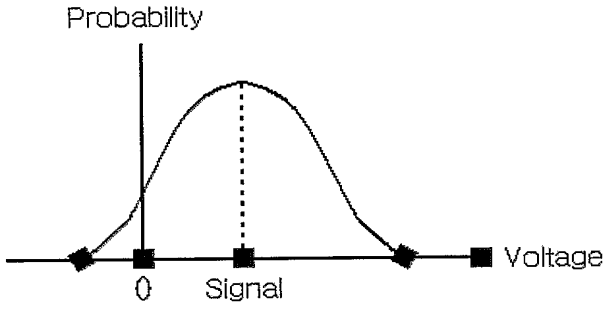
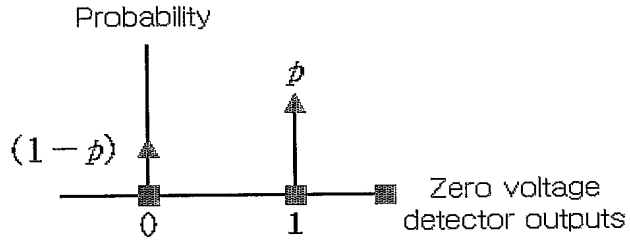

300
310
311
Shift register
312
Σ
313
Frame RAM
314
Timing controller
315
Range counter
316
Address controller
320
321
Target signal detector
322
Range reader
323
Operation controller
324
Interface/ communicator
330
Oscillator (150MHz)
Range information
Range-found data
Laser oscillation signals

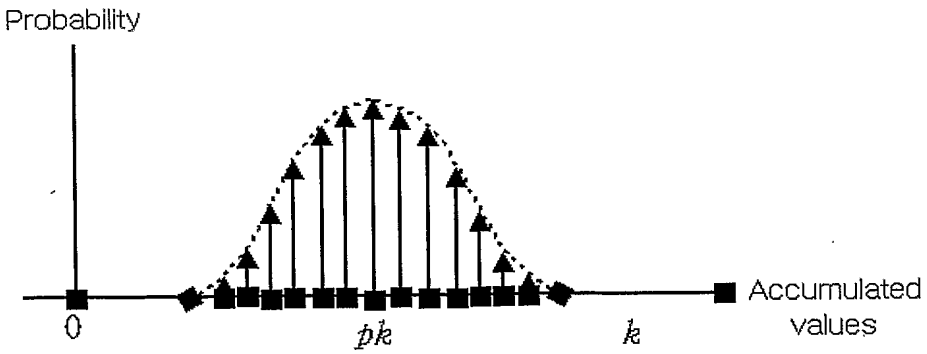
FIG.4



(a) Signals superimposed normal distribution noise



(b) Binary detection probability distribution



(c) Cumulative probability distribution

FIG.5

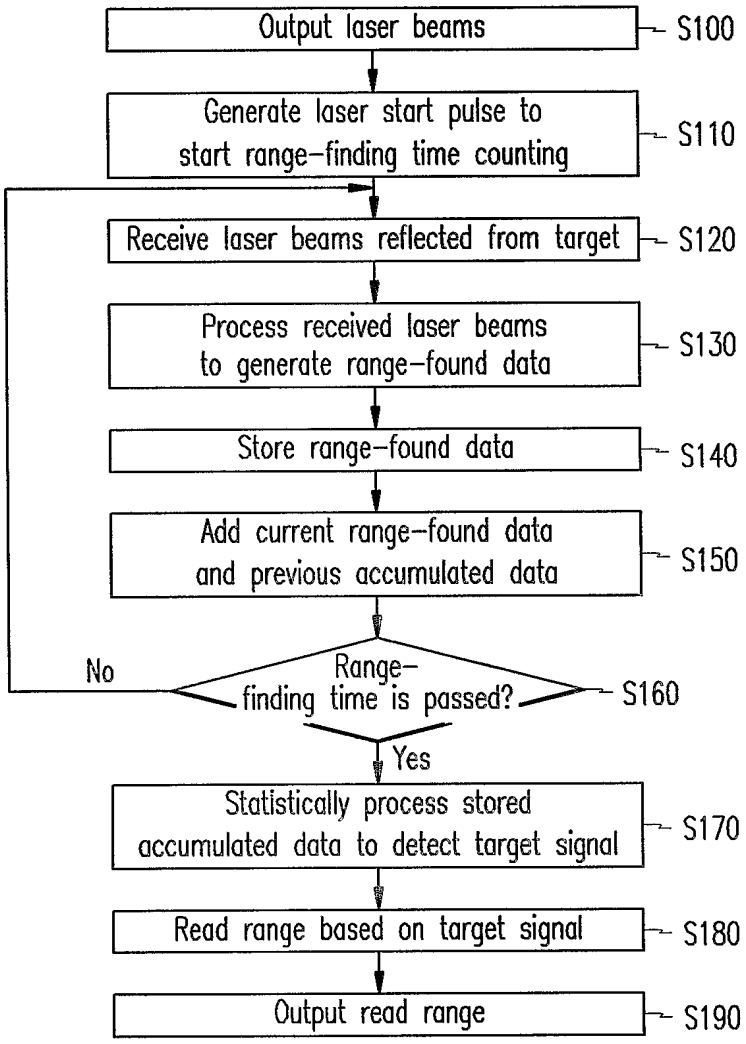

Output laser beams
S100
Generate laser start pulse to start range-finding time counting
S110
Receive laser beams reflected from target
S120
Process received laser beams to generate range-found data
S130
Store range-found data
S140
Add current range-found data and previous accumulated data
S150
Range-finding time is passed?
S160
No
Yes
Statistically process stored accumulated data to detect target signal
S170
Read range based on target signal
S180
Output read range
S190

FIG.6

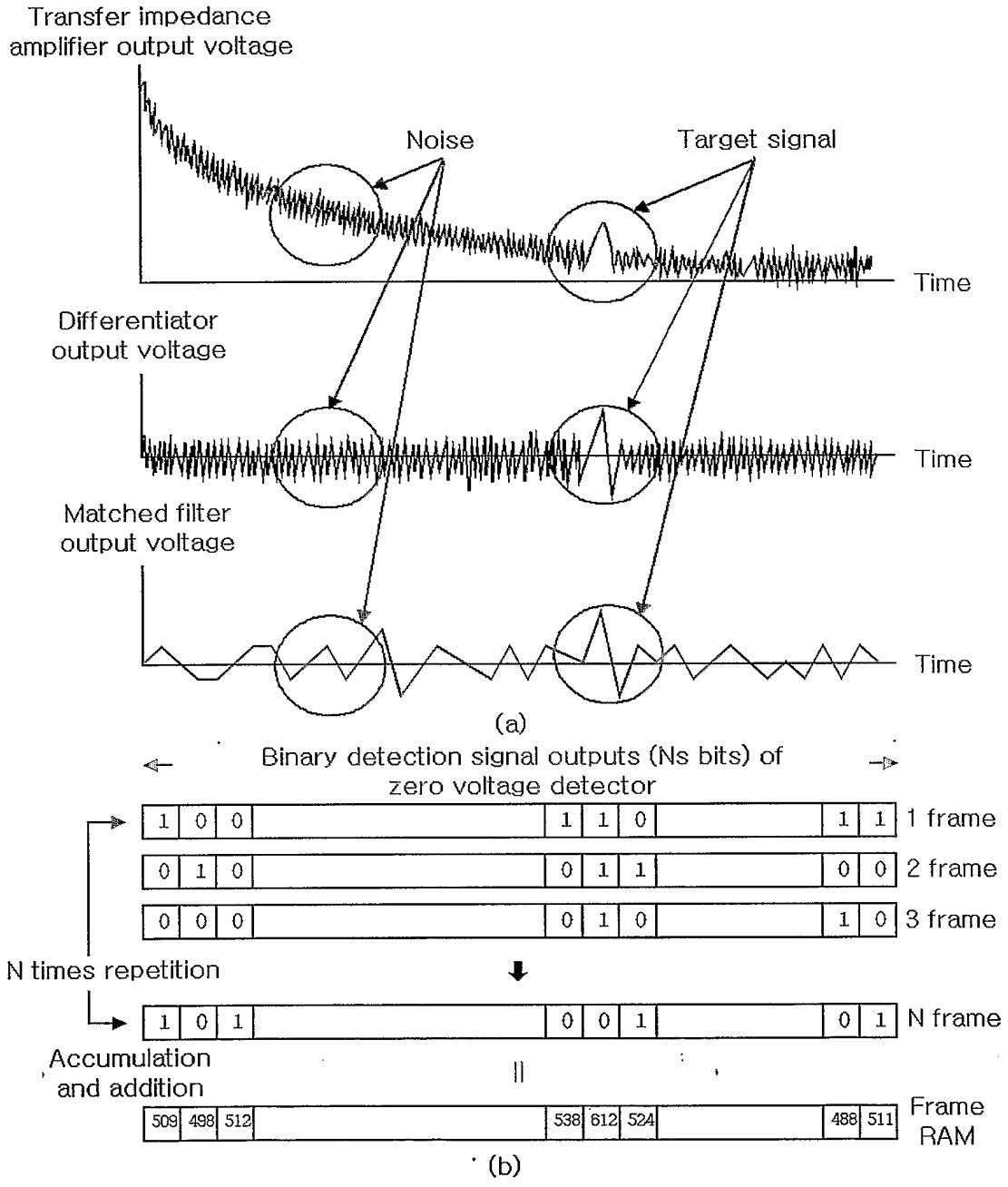

Transfer impedance amplifier output voltage
Noise
Target signal
Time
Differentiator output voltage
Time
Matched filter output voltage
Time
(a)
Binary detection signal outputs (Ns bits) of zero voltage detector
1 0 0 1 1 0 1 1 1 frame
0 1 0 0 1 1 0 0 2 frame
0 0 0 0 1 0 1 0 3 frame
N times repetition
1 0 1 0 0 1 0 1 N frame
Accumulation and addition
509 498 512 538 612 524 488 511
Frame RAM
(b)

FIG.7

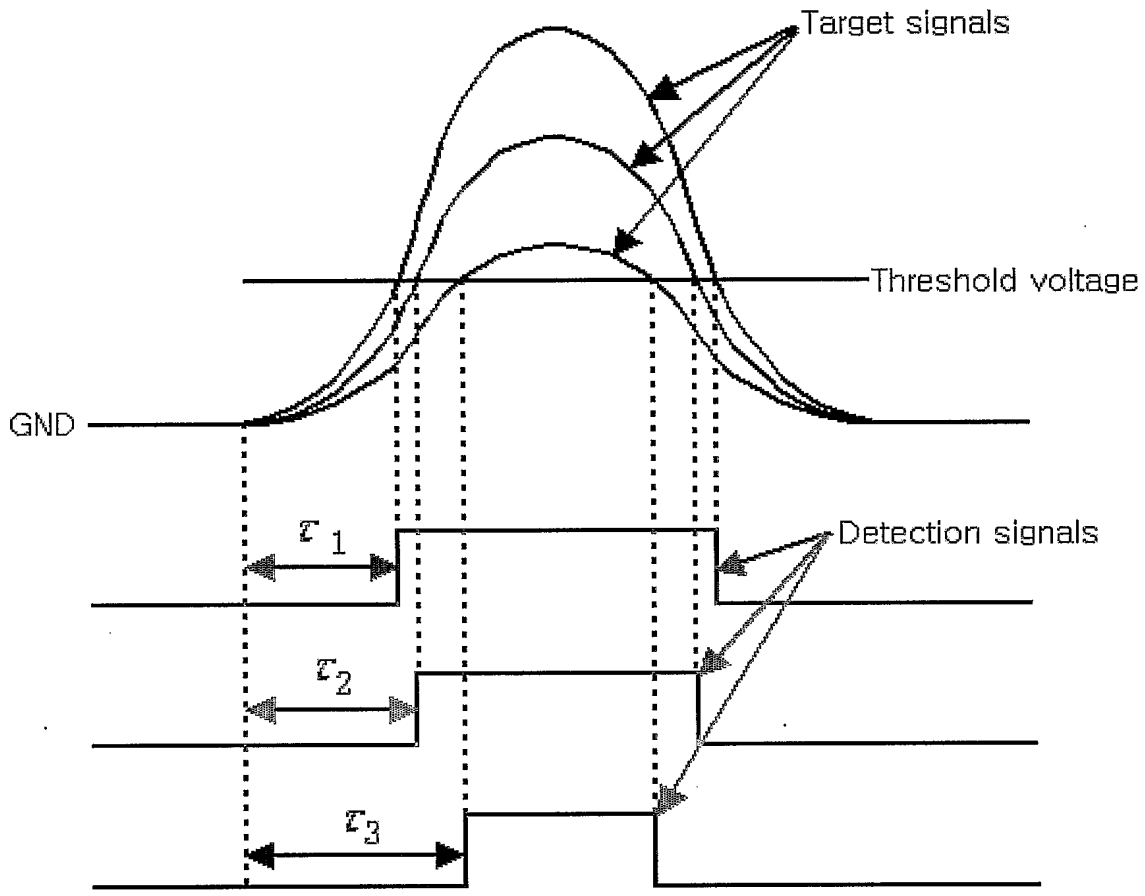
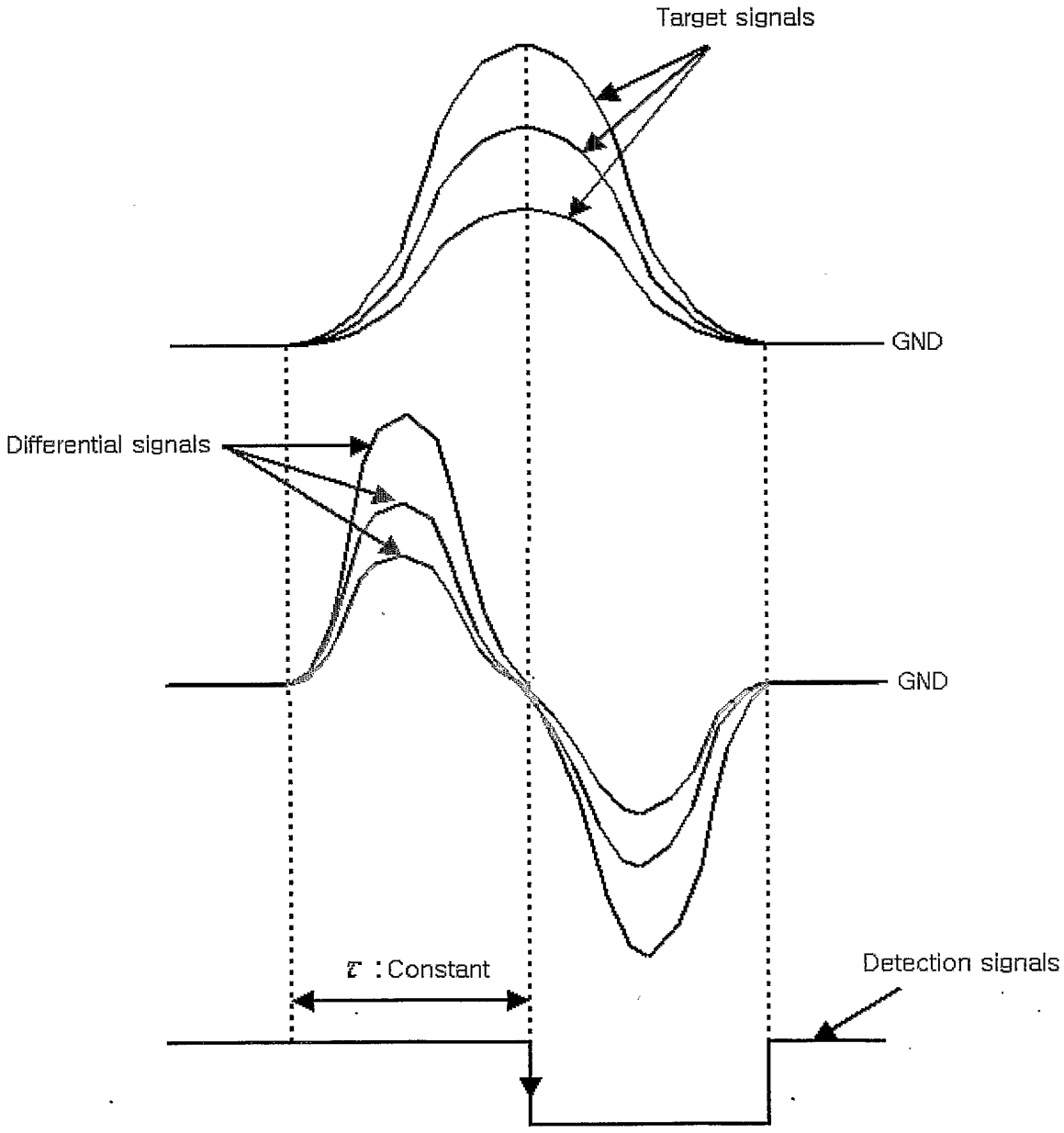

Target signals
Threshold voltage
GND
Detection signals
τ 1
τ 2
τ 3

FIG.8


Target signals
GND
Differential signals
GND
τ : Constant
Detection signals